THE HAWAIIAN PLANTERS' MONTHLY

PUBLISHED FOR THE

HAWAIIAN SUGAR PLANTERS' ASSOCIATION

Vol. XXIII.] HONOLULU, SEPT. 15, 1904. [No. 9

HENRY M. WHITNEY.

Henry M. Whitney, who for many years was editor of the Hawaiian Planters' Monthly, died in Honolulu on the 17th of last month. He was eighty years of age and was robust and active up to a very few hours of his death.

Mr. Whitney was born at Waimea, Kauai, on June 5, 1824, four years after the arrival of his parents in these islands. He left Hawaii when a very young lad to secure an education in the States. Going to the home of relatives in New England he secured an education and at an early age learned the printing trade.

He was a young foreman in the printing house of Harper & Bros. in New York, when his thoughts first again turned to his birthplace in Hawaii. He served the Harpers two years and the publication office of the Bible Society two years. Then the opportunity arrived to return here. He journeyed to San Francisco by way of the Isthmus of Panama and at San Francisco met Dr. Judd who was then travelling abroad with the two young princes who later became the kings Kamehameha IV. and Kamehemeha V. Dr. Judd wanted a practical man to take charge of the Polynesian, the government's paper. He told Whitney that they had several editors who had thrown up their jobs and cleared out to California, joining the rush to the newly-found goldfields. The young man agreed to take hold and came to Honolulu. The work on the Polynesian was not uncongenial to Whitney, but like most Americans then resident in the islands, he was irritated by the government's policy. The whalemen desired an American paper and the white residents wanted one which was not run "by authority." Whitney gave such a paper to them, calling it the Pacific Commercial Advertiser. He got from New York a Washington hand press, which had a capacity of only 600 papers an hour, and this had to be propelled by hand power. The first number of the paper was a little four-page, five-column sheet. It was a weekly. The paper had not been es-

tablished two months before the young publisher had fought and won, out of court, his first libel suit, in which R. C. Wylie, Minister of the Interior, was the complainant.

Mr. Whitney sold the Advertiser in 1870 to Black & Auld, but took charge of it again in 1878 and did not finally give up his connection with it until 1896. In 1886 he took the editorship of the Planters' Monthly and conducted it until April of last year.

Mr. Whitney sold the Advertiser in 1870 to Black & Auld, offices. He was the first Postmaster General of Hawaii, was a member of the Royal Privy Council for twenty years, and also served in the Legislature and took an active part in shaping the industrial and political progress of Hawaii.

New Varieties of Cane

A great deal of attention is given in other sugar cane growing countries to the culture of seedling canes and the raising of new varieties for the purpose of obtaining canes resistant to disease and also of developing a variety which will contain a larger percentage of sugar than the known varieties.

The Lahaina cane on some of the Hawaiiian plantations has ceased to be profitable cane; although rich in sugar it yields more readily to insect and fungus attack than does Yellow Caledonia or Rose Bamboo. And while the latter canes have to a large extent on these plantations, supplanted the Lahaina cane, they are not altogether satisfactory as sugar producers.

For some time the Experiment Station of the Hawaiian Sugar Planters' Association, has been experimenting with various canes, and the results of these experiments may show some promising varieties.

The experience of our planters with the giving out of Lahaina cane seems to be the common experience in other sugar countries. In the West Indies they are wrestling with the problem of obtaining a cane which will produce as much sugar as the discarded Bourbon (Lahaina), and although several of the new varieties have given good yields, no cane yet found there will yield as well as Bourbon on soils where that cane still flourishes.

Sir Daniel Morris, Commissioner of Agriculture for the West Indies, said in a recent lecture on the "Agricultural Industries of the West Indies," that: "These (sugar cane experiments) were devoted to raising new varieties of canes for the purpose of increasing the yield of sugar per acre and of obtaining disease-resistant canes; also to testing the relative values of manures and the most economical methods of cultiavtion. Altogether there were about 500 acres under sugar cane experiments in the West Indies. A very considerable

number of new canes was raised ever year. Only very few of these proved worthy of being cultivated on a large scale. The work was still in the experimental stage, but was nevertheless full of promise. The area planted in new seedling canes in British Guiana comprised about 13,000 acres. In Barbados and Antigua, owing to the occurrence of disease in the Bourbon cane, seedling and other canes were almost exclusively cultivated. The yield of seedling canes in many cases exceeded that of the Bourbon.

It was only as late as 1885 that the discovery was made that the sugar cane produces fertile seed, and since that time in Java and the West Indies a process of selection has been continually carried out for the purpose principally of obtaining better varieties of cane and more disease resistant. If a seedling is deemed of sufficient importance to retain, it becomes an easy matter to reproduce it from cuttings.

The following taken from L. Lewton Brain's article on "Hybridization of the Sugar Cane," published in the West Indian Bulletin, describes the method of selection adopted in Java:

"All small and weak plants (i. e., seedlings) and those whose quality do not recommend them for cultivation are cut down before the crop. This selection we rigidly carry out and up to 80 per cent. of the canes are rejected. The rest are analysed individually: a second selection is made and the canes which are richest in sugar are alone propagated by cuttings. Of 2,000 plants sown in 1899 only 100 were left in 1900 after this double selection. The following year the plants grown from the cuttings also undergo the process of double selection, first according to their outward appearance, and then by chemical analysis; this is repeated a third year.

"In Barbados, British Guiana and other parts of the West Indies, similar careful selection is carried out. Thousands of seedlings are raised every year; of these a few of the best are selected, and after careful trial on experiment plots for several years under experimental conditions in comparison with other standard canes, the best are again selected and are recommended to the planters for their final trial under estate conditions, and the planter finally selects those which he thinks suitable for cultivation.

"The objects that should be kept in view in the raising of new varieties of cane were well stated by Professor d'Albuquerque at the Agricultural Conference of 1901 (West Indian Bulletin, Vol. ii, pp. 23-4.):—

"(1) A large tonnage of canes per acre.
"(2) A good milling cane, i. e., a cane that passes through the mill without breaking off and gives a high percentage of juice.
"(3) A juice rich in sugar.
"(4) A high degree of purity in the juice.

"(5) A cane resistant to disease.
"(6) An early maturing cane.
"(7) A drought-resistant cane.
"(8) A cane of which the plant canes germinate readily.

"That the seedlings of the sugar-cane vary enormously is a well-known fact. For instance, in the British Guiana Report on the Agricultural Work in the Botanic Gardens and the Government Laboratory for 1896-1901, Professor Harrison states that 'in the majority of cases the saccharine richness of the parent variety appears not to be transmitted to either the actual seedlings or to canes propagated from them by cuttings and that similar conclusions hold good with regard to the percentage of non-sugars present in the juice.'

The difficulty that the breeder of sugar-canes has to contend with is that the vast majority of these seedlings are less valuable than the parent forms.

"The results of the work done in the selection of new varieties of sugar-cane are well known to West Indian agriculturists. Several new varieties have been introduced, some of which are proving themselves of great value in regards sugar-production, etc.. while they are far superior to the Bourbon with regard to their resistance to disease. D. No. 74 has even gone farther afield and, in Louisiana, has on trial proved itself a better cane than the Louisiana Purple and Striped."

It seems to be the universal belief of our sugar planters that the seeds of Hawaiian canes are not fertile. Experiments will be inaugurated this year to test this question and an effort will be made to raise some seedling canes.

With the establishment of sub-stations on the different islands, to be conducted under the supervision of the Director of the main station, the managers will be brought into closer touch with what is being done and their interest aroused. Up to the present only two sub-stations have been established, one at Waiakea and the other at Papaaloa, Hawaii, both of which places presented interesting questions in cultivation. The work, however, will go on and very soon it is expected that stations in other districts will be under way.

Notes on Bats

We are in receipt of a communication from Mr. W. J. Lowrie of Central Aguirre, Porto Rico, in reference to the importation of bats into the islands for the purpose of controlling certain of our insect pests, such as the mole cricket.

Mr. Lowrie is favorably remembered as the former manager of our two largest sugar plantations,—Ewa and Hawaiian Commercial and Sugar Co.,—and knowing the conditions under which sugar cane is grown here, is well able to express an opinion upon the subject. Mr. Lowrie says:

"In the Planters' Monthly for June I notice that you have quite an article on the Changa, or Mole Cricket, taken from Bulletin No. 2 of the Porto Rico Agricultural Experiment Station, by O. W. Barrett.

"It is true that here on the south side of the Island of Porto Rico there are Changas, but still I have noticed and seen very little damage done by them. Some of the old planters here, Spaniards and Porto Ricans, tell me that they were brought here years ago in cargoes of guano, but I have forgotten the name of the island they came from.

"In this connection, I notice in the Hawaiian Star of June 21, an article on the question of Bats for the Island, and they say that Professor Perkins thinks they will not thrive in Hawaii. I wish to say that here in Porto Rico there are millions of them everywhere. They have enormous caves of bat guano. I, myself, have seen several hundred tons in one cave, and the bats are so thick that I could say there is scarcely an evening that they don't fly all through our house.

"Now, these bats, of course, get their work in at night when the Changa is after his food, and the chances are, and it is very likely too, that these very bats keep down the pest, and my thought is that as they (the bats) do flourish in Porto Rico, certainly they should flourish in Hawaii, and I think Professor Perkins must be mistaken. I should strongly recommend the Planters' Association to import a lot there.

"Another thing that we have here is a great many little frogs. They, of course, get their work in at night, and between the frogs and bats we haven't many changa."

THE FORESTS OF THE HAWAIIAN ISLANDS.

BY WILLIAM L. HALL.

There are two thoroughly distinct kinds of forest in the Hawaiian Islands. One kind occurs near sea level, in the drier portions of the islands, and is valuable on account of the timber and other products which it yields. The other kind is found on the mountain slopes, where the rainfall is heavy. It has little commercial but high protective value. In no case do the two forests meet.

The Algaroba Forests.

The forests which occur near sea level consist of a single species, and this introduced. It is the mesquite of the south western United States and Mexico (*Prosopis juliflora*) and is called algaroba. The first algaroba tree in Hawaii grew from a seed planted in 1837 by Father Bachelot, founder of the Roman Catholic Mission. This tree, which is about 2 feet in diameter and 50 feet tall, yet stands in thrifty condition at the corner of Fort and Beretania streets, Honolulu. It is the progenitor of at least 50,000 acres of forest, which is fairly well distributed over the different islands.

On the Island of Oahu the algaroba forest, covering densely about 20,000 acres, extends in a narrow, almost continuous belt along the south and west coasts. In this situation it is fully protected from the northeast trade winds, which blow with great regularity from March to November—exposure to which it can not endure. The young trees are now growing in great numbers as high as 1,500 feet above the sea. It is supposed by some people that algaroba is able to grow at this elevation only by gradual adaptation. Starting at sea level, the trees were at first acclimated only to an elevation of a few hundred feet, but successive generations growing higher and higher up the slopes have at last produced trees which are able to grow at the altitude named. Indeed, since the trees now found at 1,500 feet are all young and thrifty, it seems probable that they will extend much farther up the mountain slopes than they have yet done.

On the other islands the algaroba occupies the same relative position, reaching up the dry slopes to an elevation of several hundred feet. The land which it has taken possession of is usually so stony, arid, and precipitous as to be utterly worthless for other purposes. Therefore the advent of this tree is generally welcomed by the landowner.

In Hawaii the species grows much denser, as well as both taller and straighter, than in the United States. Where fully established it shades the ground so perfectly as to keep out all competitors, and attains a height of from 50 to 60 feet. While there are no records to support the opinion, it is believed by some that the districts covered by algaroba receive more local showers than formerly.

Situated as they are, the algaroba forests are more accessible than the other forests of the islands. Indeed, there are hundreds of cases where the forest has taken possession of old feed lots and pastures on farms and sugar plantations, and even on vacant lots in towns. Some of the suburbs of Honolulu are thickly grown up with algaroba. The wood, which is valuable for fuel, sells at the plantations and in Honolulu for $9 to $10

per cord. It lasts well in the ground when used as a fence post. Both fuel and fence posts are in such great demand that there is extensive cutting in these forests.

Clean cutting is the method generally employed, and is entirely conservative, since the growth renews itself rapidly by both seeds and sprouts. Within three or four years from the time of cutting the trees again take complete possession of the ground, and attain a height of 20 to 25 feet.

An important feature of the algaroba is the value of its pods as food for stock. Pods are borne with great regularity and in abundance after the trees are 3 years old. They ripen during the summer months and fall to the ground, where they are either eaten by cattle, horses, and pigs, or are picked up to be fed. In eating the pods stock do not crush the small, horny seeds, which pass on through the alimentary system and are prepared for quick germination by the action of the digestive fluids. Stock are, therefore, solely responsible for the rapid and wide spread of this tree. Nor can it be said that their presence in the algaroba forests is noticeably injurious either to standing trees or to reproduction. No doubt they do to some extent browse on young seedlings, but in the abundance of reproduction this has no perceptible effect upon the stand.

Forming, with the exception of grasses, the most important animal food in the islands, the pods are a boon to stockmen, who fatten cattle on them during July and August, when pastures are usually dry; to liverymen, who feed them mixed with corn meal or bran during a large part of the year; and in fact to all who have to supply feed for horses, cattle, or hogs.

The algaroba forests are a valuable asset for Hawaii; they have no destructive enemies; they have tremendous powers of reproduction and extension; and, best of all, they are so highly appreciated because of the character of the ground which they cover and the products which they yield that they will be cared for by the individual without special action on the part of the government.

The Native Forests.

All of the five important islands are mountainous, their highest points ranging from 4,030 feet on Oahu to 13,760 feet on Hawaii, and all the mountains are to a considerable extent forested.

Situation.

The forests are distributed on the different islands approximately as follows:

KAUAI.

The forest covers the highest portions of the mountains toward the central part of the island, extending down to an elevation of about 1,200 feet on the windward (northeast) slope, and 1,500 feet on the leeward slope. It is practically all in one body, surrounding Mount Waialeale.

OAHU.

There are two distinct ranges of mountains on this island, both of which are forested. The Koolau Range, on the east side of the island, has much the larger forest. On this range a fairly good growth of timber extends from Pupukea and Paumalu on the north to Palolo on the south, above an elevation carying from 1,000 to 1,500 feet. The forest extends over the highest peaks of the range. The Waianae Mountains, which form the western rim of Oahu, support a fair growth of forest above 2,000 feet. As the lower elevation of this range receives less rainfall than the Koolaus the forest is limited to higher elevations.

MOLOKAI.

The only forest now remaining in the mountains of Molokai is found at elevations above 1,500 feet at the east end of the island. This forest is extremely inaccessible on account of the precipitous character of the mountains.

MAUI.

The western peninsula of Maui, though small, has mountains over 5,000 feet high. These are forested above 1,200 feet on the windward side and 2,000 feet on the leeward side.

The windward slope of Haleakala, which rises to an elevation of 10.030 feet on the main part of Maui, is densely forested up to an elevation of 8,000 feet. In this case the forest extends down to within 1,000 feet of the sea level, or even lower. The slope which it occupies is cut by so many deep gorges that it is practically inaccessible, and has never been explored. This forest extends around the eastward slope of Haleakala, through the district of Hana, and a belt of it has in the past extended almost entirely around the mountain, at an elevation of from 4,000 to 6,000 feet. This belt is now largely destroyed on the western and southern sides of the mountain.

HAWAII.

The windward slopes of the Kohala Mountains of northern Hawaii are forested above the sugar plantations to the summit of the mountains. But on the leeward side the forest has been destroyed almost to the summit. Between Honokane and Waipio, where the mountains break off sharply into the sea, the forest extends to sea level. From Waipio to Kukaiau, in Hamakua, but a thin belt of forest now remains adjacent to the sugar plantations. This forest forms a part of the Parker ranch, and all portions of it are grazed. In the southern part of Hamakua, where the influence of Mauna Kea comes in to increase the precipitation, the forest rapidly widens and reaches in a great loop around Mauna Kea at an elevation of from 6,000 to 8,000 feet. In Hilo it extends to a width of 20 to 25 miles on the gradual slope of Mauna Loa, but in Puna it is brought to a sudden limit where the rainfall ceases and the desert begins. In Kau another forest begins, and extends continuously through western Kau and Kona at elevations of 3,000 to 6,000 feet.

TROPICAL CHARACTER OF FORESTS.

The native forests are distinctly of tropical character. None of the familiar trees of the north temperate zone are present. The observer looks in vain for oaks, maples, pines, or spruces. There is one representative each of Sapindus, Sophora, and Zanthoxylum, and two or three of Acacia, but all differ distinctly from their congeners in the United States.

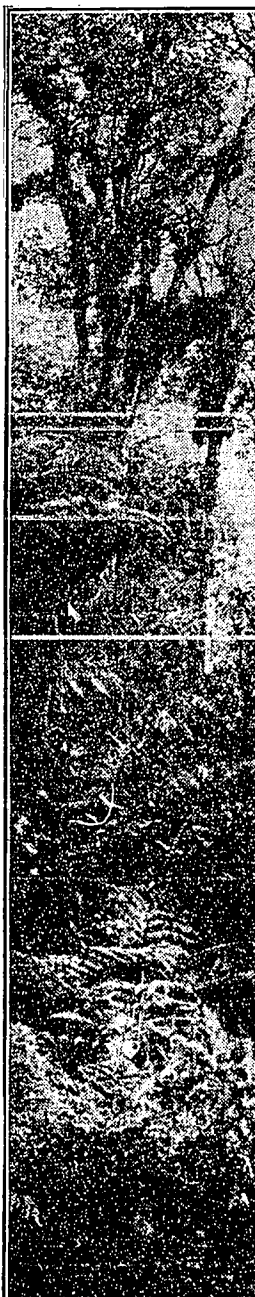
FOREST TYPES.

The forests are composed mainly of five distinct types: Pure growths of lehua, koa, mamane, and kukui, and mixed forests, which are made up of koa, koaia, kopiko, kolea, naio, pua, and other species.

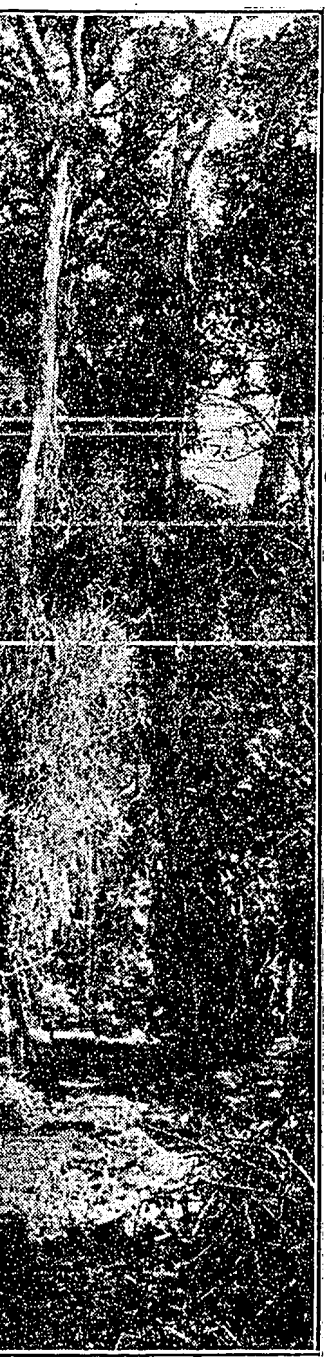
Lehua.

The ohia-lehua (*Metrosideros polymorpha*), which forms pure stands or grows with a small admixture of koa, naio, kopiko, and pua on all the different islands, is the typical forest of regions of very heavy rainfall, such as northeast slopes and mountain tops under 6,000 feet elevation. It comprises probably three-fourths of the native forest.

The lehua of itself seldom forms a dense stand. The trees are apt to grow far apart, and always have small, thin, upright crowns, which are very intolerant of shade. Under



INTE



FOREST.

varying conditions in the forest the trees grow from 30 to 100 feet high. In the best forests, which always occur where the rainfall is greatest, many of the trees reach a diameter of 4 feet, a height of 100 feet, and a clear length of 40 to 50 feet. The lehua trunk is straight, often twisted, deeply ribbed near the ground, and frequently divided into several roots 10 or 12 feet above the ground. The root system is very shallow, often spreading right on the surface of the mineral soil.

Though the stand of trees be thin, the normal forest, on account of an abundant and luxuriant undergrowth, is impenetrable except as one cuts his way with knife and axe. Many of the trees support climbers such as the ie-ie vine, which grows into the crowns and may lace together with rope-like stems the trees of an entire forest. Then there is the fern growth, marvelous in its variety and luxuriance. With species which range in height from a few inches to 30 feet, growing both on trees and on the ground, and running the whole scale of shade endurance, the ferns do much toward making the virgin lehua forest the impenetrable, dark jungle which it often is. Mosses in places cover the ground, fallen logs, and tree trunks several inches deep, and grow in bunches over a foot thick on suspended vines and drooping twigs, giving an appearance of weird drapery.

Undergrowth of this kind affords a great quantity of humus, and possesses an enormous capacity for holding water. Even in a rather dry time one may squeeze enough water from a few handfuls of moss to obtain a good drink. Fallen logs, fern trunks, and all kinds of debris are constantly saturated. Mountain ridges less than a rod wide at the summit are often boggy where these conditions prevail.

In so dark a forest it seems anomalous to find the lehua, a tree of pronounced intolerance, reproducing itself generation after generation. It does so through its singular habit of germinating on both standing and fallen trees, and especially on the fibrous trunk of the tree fern, which is admirably suited to its needs. Only in such places can it get the light it requires. As soon as it germinates it sends down several roots, which enter the ground and perform the normal functions of support and nutrition. When the host decays, the tree is left standing on these roots, which to all appearances are simply divisions of the trunk. The natives have an adage that the amau (tree fern) is the mother of the ohia lehua.

As one passes above an elevation of 4,000 feet, or out of the districts of greatest rainfall, the lehua relinquishes its prominent place and mingles with other species, such as the naio, kolea, kopiko, koaia, and koa.

Lehua wood is of reddish color, heavy, and in drying checks and warps so badly as to be of little commercial use except for fuel. It has been used frequently by the natives in the

building of log houses, and has also been used on the islands for railroad ties.

The lehua forms the tallest and most impenetrable forests on the islands, and because of its character and of the fact that it covers districts where the rainfall is greatest and the mountains most precipitous, it forms the most valuable protective forest. Nearly all the districts which accumulate a large supply of water available for irrigation and fluming purposes are covered by lehua forests.

Koa.

Besides growing in mixture with lehua, koa (*Acacia koa*) forms pure stands over extensive tracts in Hawaii and Maui. Koa has a leaf which is almost indistinguishable from the Australian blackwood (*Acacia melanoxylon*), which has been commonly planted in southern California and to which it is closely related botanically. It is naturally a spreading tree with a short trunk, growing in somewhat scattered stands. Occasionally under normal conditions it reaches a diameter of 6 or 8 feet and a height of 75 feet. Much greater height than this is reported.

In crowded stands the koa is forced into a long, slender, but seldom straight stem. It is intolerant of shade at all ages, and will not germinate or grow without a large amount of light. Koa also has the fern undergrowth which characterizes the lehua, though as it grows in somewhat drier situations its undergrowth is usually not so luxuriant. The ie-ie vine especially is seldom seen in a koa forest.

Koa is the one fairly abundant tree of the Hawaiian forests which is valuable because of its lumber. It is highly prized cabinet wood, which has been largely used on the islands and has also been exported in limited quantities. Its color varies through many rich shades of red and brown; its grain is fine and indistinct. Curly koa is especially prized, but is very rare. Most of the best koa on Maui has been cut, but an extensive mature forest exists in Hilo and Puna at elevations of from 4,000 to 6,000 feet. This forest is but little known, but seems to contain some magnificent timber and to be in good state of reproduction. Practically all of this forest is upon accessible government land, and could be utilized to great advantage should the government build a road to it and establish a sawmill for working up the mature trees.

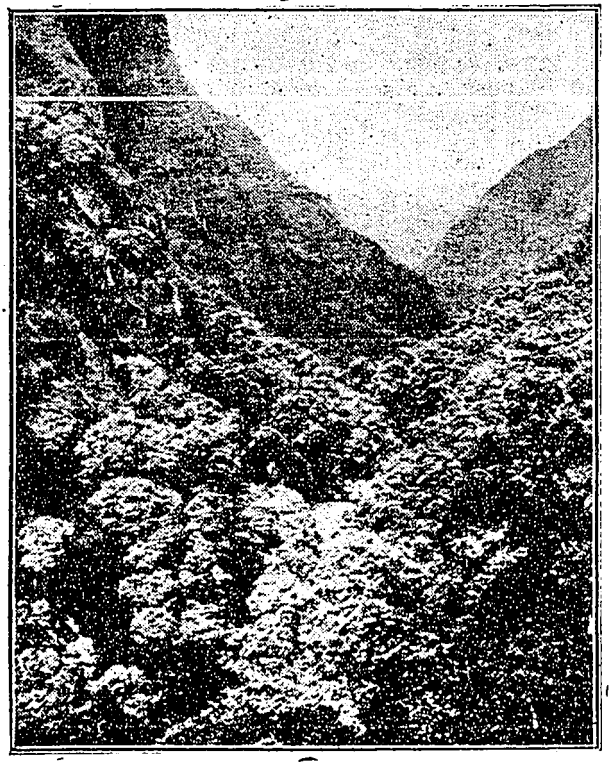
Mamane.

Mamane (*Sophora chrysophylla*) grows successfully only on the high slopes of Mauna Kea and Hualalai. It originally extended down to an elevation of about 4,000 feet on the north

A HAWAIIAN KOA FOREST.

slope of Mauna Kea, but was killed out at this elevation apparently by the encroachment of Bermuda grass (manienie). But little of it is now found except between 6,000 and 8,000 feet, at which elevation it forms a belt clear around Mauna Kea. In this situation it is notable for its rapid extension within the last few years both up and down the mountain. This extension has taken place in spite of heavy grazing, and forms the only example of the extension of the natural Hawaiian forest under such conditions. Unlike the case of the algaroba, cattle seem in no way responsible for the extension of the mamane, as they eat neither the seed nor the fruit. The seed, borne in great profusion, is readily disseminated by wind and water. Mamane also grows abundantly on Maui, particularly on the slope of Haleakala, at from 6,000 to 8,000 feet above sea level. It is not abundant on the other islands.

Mamane is the best post timber of the native forest, and for this reason is a useful tree to the ranchman. It is not of great value as a soil cover, because it neither forms a dense stand nor is supplemented by a heavy undergrowth.



KUKUI FOREST, BOTTOM AND SIDES OF DEEP GULCH.

Kukui.

Kukui (*Aleurites triloba*), a handsome tree with large, silvery leaves pointed like the leaves of the California sycamore, characterizes the bottoms and sides of gulches and streams to an elevation of 2,000 feet. It is frequently called candlenut, because of the oily nut which it produces in abundance, and which in olden times was used by the natives for illumination. The kukui has value only as a cover for the steep slopes where it grows. In almost all cases it has beneath it a dense undergrowth of fern. In very moist coves, protected from severe winds, the wild banana often forms a part of its undergrowth. Near the edges of streams the kukui is frequently supplanted by the ohia ai, which, in small patches, forms the densest forest to be found in the islands.

Mixed Forests.

Mixed forests of koa, koaia, kopiko, kolea, naio, pua, and other species occur on nearly all the islands, particularly on portions too dry for the species above named to form pure forests. Thus, on approaching a forest area from a desert, one encounters first a mixed forest and afterwards a pure forest of some of the kinds mentioned. Forming thus the edge of the natural forest, and occurring often on plains or gentle slopes, the mixed forests have suffered more from grazing than any other type. Very many of them have been almost entirely exterminated, as, for instance, those on the leeward slopes of the Kohala Mountains of Hawaii and those on the upper portion of Kula, on Maui. The mixed forests have often been injured by grasses, particularly the Bermuda grass, which thrives under the same natural conditions.

Limits of the Original Forests.

Originally the forests were limited only by such natural conditions as lack of rainfall, elevations and lava flows.

The northeast trade winds keep the windward mountain slopes saturated by frequent rains during the greater part of the year, and on these slopes, at elevations of 1,500 to 3,000 feet, where the rainfall is greatest, is found the heaviest forest. Toward regions of lessened exposure to trade winds and decreased rainfall the forest becomes thinner and of poorer quality, and on the leeward, where the rainfall is in places less than 30 or 40 inches per year, there was often no forest at all. Probably the area which originally bore no forest because of insufficient rainfall was quite large, for it is certain that all of the important islands now have large tracts to which no trees of the native forests are adapted.

Elevation has put a sharp limit to the forest on the islands of Hawaii and Maui at from 6,000 to 8,000 feet. This leaves very large areas of Mauna Loa, Mauna Kea, Hualalai, and Haleakala devoid of forest, and they have always been so. The mountains of the other islands, being under 6,000 feet, are forested to their summits. Six to eight thousand feet is a surprisingly low timber line, considering the favorable conditions of soil, moisture, and temperature which prevail at that altitude in Hawaii. The sufficient reason seems to be that the species composing the native forests are all representative of the torrid zone, and in these islands, which lie right at the edge of the Tropics, find their limit at the low altitude named.

On the slopes of Mauna Loa lava flows have put a sharp limit to the forest in a number of places. The flow of 1881, which ran from near the top of the mountain almost to the sea, cut a wide swath through a dense forest for fully 15 miles. Many previous flows had resulted similarly, and while the forest is slowly replacing itself on the older flows, hundreds of years are required for the lava to decompose sufficiently to support a normal growth of forest. Many thousand acres which once must have been well forested are now surfaced with lava rock (pahoehoe), and support only a meager growth of fern and stunted trees. Slowly this rock is decomposing, and as it decomposes the forest improves.

Rapid Decadence of the Forests.

The above were the chief agencies restricting the forest up to about one hundred years ago. Since that time various deleterious agents have worked so effectually toward the destruction of the woodland that every forest in the islands has been reduced, until it is now only a fragment of what it was originally. The Island of Molokai well illustrates this point. This island, 38 miles long by 8 miles wide, has a range of mountains over 4,000 feet high at its eastern end, drops to a low plain in the center, and rises to 1,380 feet near the western end. Originally all the eastern end well down to the central plain, and the highest part of the western end, were heavily forested. The plain was park-like, with scattering groves of trees. There is little at present even to indicate former conditions. All the western end is bare. The trees are gone from the plain, and also from the western and southern slopes of the mountains at the eastern end. Only a few thousand acres of the highest south slopes and the precipitous north slopes of the mountains are now covered by growing forest. Stretching around the living forest is a wide belt of leafless timber, which has died within the last decade, but has not yet fallen.

Each of the other islands exhibits just the same conditions. More marked examples of declining forests can scarcely be imagined than exist in the districts of Hamakua and Kohala in Hawaii, and Kula in Maui, in which one may pass through thousands of acres of totally dead forest into equal areas of which the forest is in a dying condition, and from these into the small remnant that yet remains thrifty.

No estimate can be given of the ratio of the present forest to that of a century ago. The former area is unknown, and the present forests are so inaccessible and so irregular in shape that a safe estimate can not be made without much further study. But it is certain that the present area, which may not be more than 20 per cent of the islands, is but a small part of what existed at that time. This result has been brought about by perfectly evident causes working unretarded year by year.

Causes of the Decline.

The principal causes which have brought about the destruction of the forests are stock, insects, grasses, fire, and clearing.

STOCK.

Cattle were introduced into the islands late in the eighteenth century. They were turned out to run at large, and strict laws prohibited their slaughter for a number of years. Under these favorable conditions they had increased to such numbers by 1815 as to be a menace to the forest. Their slaughter was no longer forbidden, but they continued to multiply rapidly. By 1850 boiling plants had been put up in several places for the extraction of tallow, that being the only portion of the animal having any value. These plants were in continuous use until the seventies, and indicate the great numbers of cattle which must have existed during that time. Only within the last few years have cattle been reduced in numbers to conform to the demands of the islands, and placed within fenced paddocks. Numbers of wild cattle still run at large in the various forests, although many have been driven out or shot. Mr. A. W. Carter, manager of the Parker ranch, on Hawaii, estimates the number of wild cattle on Mauna Kea to be 10,000.

That cattle did the first serious damage to the forest can scarcely be doubted when one considers their great numbers and the extent of the forest. At a very early day they must have gone through all the accessible parts. The more inaccessible and impenetrable parts remained intact till later, for cattle could only work around the edges of these, entering a

little further each year; but now in many instances they have gone through the entire forest.

The character of the Hawaiian forest makes it peculiarly susceptible to injury by cattle. The tender, succulent undergrowth is easily trampled down, and much of it, especially ie-ie, banana, and some of the ferns, is excellent food for stock. Yet this undergrowth is a vital part of the forest; without it the ground dries quickly and the shallow-rooted trees soon die.

Goats were introduced into the islands many years ago, and have been particularly active agents of destruction. They are now found on all the important islands. Their work, though localized, is more thoroughly destructive than the work of cattle. Ridges where they rendezvous may be distinguished for miles by their utter barrenness and eroded condition. Goats are especially hard on precipitous slopes. They will lay completely bare places so steep as to be shunned altogether by cattle.

Wild pigs, the progeny of stock introduced years ago, have done some damage on all the islands. They tear up the tree fern, seeking its roots for food.

Deer brought to Molokai in the early sixties have taken their share in the destructive work. Several years ago they had increased to such immense numbers as to damage the forest considerably by browsing on and trampling down the undergrowth and rubbing the bark from the young trees.

INSECTS.

Following the attack of stock have come other agents of destruction. Injurious insects have at times appeared in numbers sufficient to deaden and even eventually to kill the timber over thousands of acres at a time. Ohia-ai, which grows in dense stands in low, wet valleys, was so completely defoliated a few years ago as to be almost ruined. Koa is periodically defoliated. It has upward of a dozen insect enemies which threaten its utter extinction. Borers are even more common than leaf-eating insects. In nearly all cases insects have been most severe where the forest was enervated by grazing. Portions of the ungrazed forest have at times been destroyed by insects, but only in consequence of the headway gained on near by areas which have suffered by grazing.

GRASSES.

Many thousand acres of forest land despoiled by cattle have been overrun by rank-growing grasses, which have rendered conditions prohibitive of forest reproduction. Probably the worst of these is Hilo grass (*Paspalum conjugatum*), which grows 2 to 3 feet high in the rainy districts and forms a dense

mat several inches thick over the surface of the ground. Tree seeds can not germinate beneath it. Another coarse grass of similar habits is the so-called rice grass (maulike). But it is neither so common nor so prohibitive of reproduction as Hilo grass.

In drier districts Bermuda grass (manienie) obtains such a hold as to prevent forest reproduction, and even to hinder tree growth. Some of the forests of Hamakua and Kohala, in Hawaii, have died from no other apparent cause than a predominant growth of this grass.

FIRE.

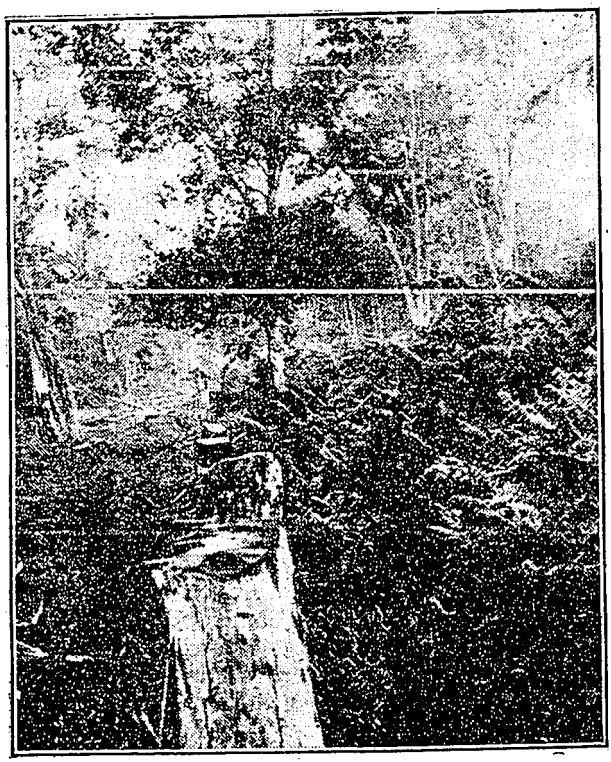
Fire has done far more injury in Hawaiian forests than would be supposed in regions of so great rainfall. The most serious fire within recent years occurred two years ago in southern Hamakua. It burned an area of 15 miles long and 2 to 4 miles wide, leaving unburned only occasional patches. Trees, undergrowth, and humus were generally completely destroyed. The forest was a normal one for the islands, consisting of a fairly heavy growth of lehua and koa, with a heavy undergrowth of fern and a deep accumulation of humus. Ordinarily this forest could not have been burned, but a severe drought prevailing for several months previously had dried it out to the point where it burned with great rapidity. At the present time the land is covered with fallen trees and debris, and in places a growth of weeds. But little reproduction has as yet taken place, and, as practically all seeds and seed trees on the area were burned, there is no possibility of immediate reproduction. Whatever growth comes up on the land must come from seeds carried in from other places.

Other forest districts, particularly on Kauai and Maui, have also suffered from fire, though there have been no other recent burns so severe as the one mentioned above.

There is distinct evidence of a severe fire upward of fifty years ago in the southern part of Hamakua. This fire burned over a tract of large, though unknown, extent. It killed practically all the forest and undergrowth, and consumed the humus. Its heat must have been intense, for it baked the soil to such an extent that at the present time it shows as a brick-like layer from 2 to 6 inches thick. In many cases it burned the roots of trees several feet below the surface. The forest which has come up on the ground following this fire, though composed of the same species as the ordinary Hawaiian forest, differs from it distinctly in conditions and requirements. The trees have grown slowly and have less than the usual amount of undergrowth, but they have far greater power than the normal forest to withstand grazing.

CUTTING.

The forest has been considerably reduced by cutting. Destructive cutting began by the removal of the sandalwood in the early part of the nineteenth century, and has continued intermittently till the present time. Except the sandalwood and koa, the main uses of the native timber have been for fuel and poles. Large quantities of native timber have been used for fuel in the past, but the demand is now very largely supplied by the algaroba. Most of the sugar mills, which have been large consumers of native wood, have now turned to other kinds of fuel. Some use coal, some oil, and some the tailings of the cane (bagasse). In southern Hamakua and



GRAZED LAND ON LEFT SIDE OF FENCE; RIGHT SIDE PROTECTED FOR SEVEN YEARS.

Hilo, on Hawaii, a few of the mills are still consuming a large amount of native wood, and two or three, with surprising lack of foresight, are cutting away the timber which lies just above their plantations and upon which probably their water supply largely depends.

The Crucial Question on the Island of Hawaii.

At the present time a good deal of land is being cleared for the extension of cane fields and for the establishment of homesteads in Hamakua, Hilo, and Puna. The wisdom of the removal of these forests is a grave question, and there is emphatic difference of opinion concerning it.

The whole northeast coast of Hawaii receives a variable but heavy rainfall, and was originally forested to the shore of the ocean. Years ago this region was found to be adapted to the growth of sugar cane without irrigation. Plantations sprang up rapidly, and soon formed a continuous chain from the north point of Kohala to several miles south of the town of Hilo, with the exception of the country between Honokane and Waipio, where the mountains break off squarely into the sea, leaving no cultivable land. As the land near the sea is all occupied, the only direction in which the plantations can extend is up the mountains; and this, many of them have continually striven to do. Already the land has been cleared to an elevation of from 1,400 to 2,500 feet. In Hamakua there remains above the plantations a strip of forest varying from 1 to 4 miles wide. It is into this remaining strip that some of the plantations wish to extend.

The sugar companies do not own very much of this land. It is owned principally by the Territorial government, which leases it to the sugar companies and gives them permits to clear it. Several requests are pending now for permits to clear land above the present limit.

Now, it is recognized by sugar planters, landowners, and government that a limit exists above which clearing means the ultimate disaster to the sugar industry. In the opinion of some this limit has already been reached. During the early part of the present year an expression of opinion of the plantation men was obtained as to what limit should be set for clearing. Most of them favored a limit below the 2,000-foot contour. Nevertheless, some of the managers are very anxious to extend their plantations beyond this limit.

The opening up of large tracts of forest lands for homestead purposes has also complicated the problem seriously. Several years ago a preliminary trial indicated that coffee could be successfully grown in this region, and the insular government, importuned by those who desired to engage in its cultivation, threw open to settlement several large tracts lying just above the sugar plantations in Hamakua and Puna. Clearing and coffee planting went on rapidly for a few years, but came to a sudden halt when it was discovered that the coffee trees bore only a crop or two and then failed. Something had to be done with the homesteads. The most con-

venient thing was to turn them over to the sugar plantations, and this in most cases was done. Thus the possibility of using the homestead law for extending the sugar plantations was demonstrated. The pressure for opening tracts, ostensibly for homesteads, has continued. Several tracts have been opened within the past few years, and the opening of others is under consideration. In a great many, probably a majority of cases, the homesteader has sold first the timber and then the cleared land to the plantations, for the settler has found it more profitable to dispose of his homestead in this way and afterwards work for the plantation than to till the land.

Attempts to farm these homesteads have signally failed. The rainfall is too great for some crops, and those which could be grown are usually devoured by insects, which seem to be always present in astonishing numbers. If by chance the homesteader manages to grow a crop he finds it difficult to get it to a shipping point over the mountain roads. The shipping rates to Honolulu, which is practically the only market on the islands, are excessive. And in the Honolulu market it is impossible for the Hawaiian farmer to compete with California in dairy products and cereals. Except for specialized crops, which will have high value in proportion to their bulk, farming in these districts is absolutely without promise of successful returns.

The question may be asked, If sugar is so profitable a crop on this land, what reasonable objection can be raised to cutting away the forest and growing sugar cane upon it? The danger is that the plantations may go so far in the matter as to bring ultimate disaster upon themselves by ruining their water supply and decreasing the rainfall. Many of the plantations now obtain water from the mountain streams for fluming cane to the mills. There is scarcely enough water for this purpose, and it has been noticed that with the clearing of the lower slopes these small streams have been perceptibly diminished.[a]

The other and far more dangerous result to be feared in cutting away the forest is the modification of climatic conditions so that there will not be enough rainfall to insure the growth of sugar cane. Kohala and Hamakua have barely enough rainfall to produce good crops during the best seasons. Dry seasons cut down the crop till there is often no profit in it. In 1901 these districts produced 52,025 tons of sugar, worth $4,080,505—15 per cent of the entire crop of the islands.

[a]The porosity of the soil in this district is remarkable. Between Waipio and Laupahoehoe there is scarcely a single stream affording enough water to flume cane, and even in portions of Puna, where the rainfall is from 150 to 200 inches per year, there are no streams whatever. The water which falls all sinks directly down and appears in the form of springs only at the edge of the ocean.

In 1902 they produced only 17,079 tons, in consequence of a severe drought which affected the crop greatly. The crop of 1902 is said to have been produced at a loss to the planters. Frequent droughts such as that would soon put an end to the entire sugar industry in these districts for there is no possible supply of water except rainfall.

Throughout the Hawaiian Islands, but especially in these two districts, the influence of the forest upon both the amount and distribution of rainfall is a matter of common observation and experience. Back of the sugar plantations in Kohala and most of Hamakua the land does not rise above an elevation of 3,000 feet, and therefore lacks the heavy rainfall which results from higher elevations. As the forests have occupied the land above the plantations they to a certain extent have answered the purpose of the mountains in cooling the atmosphere and causing the saturated trade winds to relinquish their moisture over the plantations. The evidence of this influence is convincing, and seems capable of demonstration to some extent by measurement. On the plains of Hamakua and the lower northeast slope of Mauna Kea, where heavy fogs blow over from the ocean and mists are of almost daily occurrence, the top of a single tree condenses enough moisture to make the ground beneath it muddy, or even to cause water to stand, while beyond the influence of the tree top the surface of the ground may be entirely dry. At Punohu, where the Parker ranch maintains a dairy, there is a short row of vigorous eucalyptus about 100 feet high. These trees condense so much water that the ground beneath them is always muddy. The ranch has taken advantage of this unusual circumstance by placing beneath the tree tops a roof of sheet iron which collects the water and runs it into a gutter, which leads it into a tank. The water thus collected is sufficient for a large number of stock.

Since the reduction of the forest area has perceptibly diminished the flow of water for fluming, and has decreased and made irregular the rainfall, it is reasonable to expect that the removal of the entire forest would make the water conditions so precarious as to reduce greatly the productiveness of the plantations, if not to ruin them entirely.

Necessity for the Clearing of Land.

Speaking of the islands as a whole, it must not be supposed that the removal of the forest has been unnecessary or without beneficial results. It was necessary to clear land in Hawaii for tillage and pasturage, just as it has been in the United States. Without the clearing of large areas of forest land the products of the islands would not, as at present, exceed $25,-

000,000 a year. The islands would not, as they do now, supply cattle for the present population.

But the point has been reached in most districts where the removal of the forest can not proceed except at the serious injury of existing industries. The best sugar-producing lands and most of the best grazing lands are now cleared. The forest which remains is that which controls, nay, even in some cases gives origin to, the water supply.

Importance of Remaining Forests.

It can not be asserted that the native forests have great commercial value, for the reason that the trees which compose them are not, for the most part, commercially valuable. But for protecting the mountain slopes, and for gathering and distributing a useful supply of water, they have a value which, in the opinion of many, it is difficult to overstate. They lie directly above the cane fields, in many places cover steep, even precipitous slopes, receive from 50 to 200 or more inches of rainfall per year, and possess so great a retentive power that they distribute very evenly this tremendous quantity of water.

The land which depends upon them for a regular supply of water produces, in sugar and rice, crops of immense value. In 1903 the value of the sugar exported from the islands amounted to $25,310,684, or 96 per cent. of the total exports. Sugar is the sustaining crop of the islands. Other industries flourish largely because the sugar industry exists.

Large tracts of land suitable for the production of sugar cane still lie out of use because there is no water supply for them. Many of the lands already producing sugar would be far more productive with a more abundant and regular water supply, as is evident from the short crop in Kohala and Hamakua in 1902, which fell to 33 per cent. of the normal production because of drought.

In so far as watersheds have been denuded, the results have been disastrous and quickly felt in a dwindling water supply and the decreased productiveness of land. On the other hand, the protection of denuded watersheds has been accompanied by the most remarkable results in improved water conditions. In some cases the water supply has been in this way so largely increased as to permit of considerable extension of the cane fields.

The abundant evidence that the forest has a direct influence on the increase of rainfall, at least in certain localities, has already been noted.

Although the native forests are not of commercial value now, they may be made so within a reasonably short time if placed under management. A large koa forest exists on the slopes of Mauna Kea and Mauna Loa, the products of which

would be highly valuable if got out at reasonable expense and placed on a good market. A large part of the rest of the native forests may be brought to commercial value before many years by the planting of valuable lumber trees.

Commercial Interests Concerned in the Forests.

Those business interests which, like rice and sugar production, are largely dependent upon the mountains for a supply of irrigation water naturally in most cases strongly favor preserving the mountain forests. With them this means a regular and maximum flow of water, which in turn means steady and heavy production of sugar. So strong has been the interest of some of the sugar companies in the preservation of the forests that they of their own account have maintained large forest reserves above their plantations. Notably among them are the Lihue plantation in Kauai, which has had fenced off for ten years a tract of about 10,000 acres, and the Pahala plantation in Kau, Hawaii, which for seven years has maintained a reserve of some 50,000 acres. Private and corporate landowners who lease land to ranches and plantations have also reserved the forest, in some cases making it a condition of the lease that the forest be fenced and fully protected. The B. P. Bishop estate, the largest landowner in the islands, with the exception of the government, has thus reserved five tracts in Oahu and Hawaii, aggregating about 50,000 acres.

Equally noteworthy is the tree-planting policy which has been faithfully carried out by a number of landowners. Rev. Hans Isenberg, president of the Lihue plantation, has planted several large blocks of forest. The most extensive tree planter of the islands is Mr. H. P. Baldwin, of Maui, who for years has systematically planted blocks of forests on his lands on the lower slopes of Mount Haleakala. Mr. Baldwin has now growing many hundred thousand planted trees of eucalyptus, koa, Casuarina, Grevillea, and Java plum.

Occupying a different position from those who desire to keep the forests fully protected are those whose business is not dependent upon the water supply from the mountains and who could really use the forested land to great advantage, namely, the ranchmen. Some of the very lands whose protection is of vital importance to the sugar plantations are excellent grazing lands, and greatly needed by the ranchmen who use them. And yet the line of personal interest is not so clearly drawn as may be imagined. Many of the ranchmen are also largely interested in the sugar plantations, and while they may be reluctant to give over for forest purposes some of their grazing lands, their other interests lead them to favor strongly, for the islands as a whole, a policy of forest protection. Even the ranchmen who are not concerned financially in sugar produc-

tion, while not of course forgetting their private interests, are inclined to take a broad view of the situation. They realize that the development of the sugar industry means the development of the whole Territory, and consequently increased and stable markets for their own products. Indeed the ranchmen as a rule take a most reasonable attitude on the question.

It is fortunate indeed that there is no general clashing of interests on the question of forest protection. In the local cases, where general welfare apparently opposes individual interests, a reasonable administration will in almost every instance be able to give entire satisfaction by the exchange of lands held either by leasehold or in fee simple.

The Government's Interest.

The government's course is plainly to seek such management of the forests as will secure the greatest productiveness of the commercial interests concerned. The plantations need an increased and regular water supply. Therefore, the forests must be protected in order to give it. But the system of protection must not be extended so far that its damage to the ranches will outweigh its benefits to the plantations. Each local problem will have to be worked out fairly and squarely, with due consideration of all the interests at stake.

Government Forest Work in the Past.

Hitherto the government has given attention principally to the question of forest planting rather than to the preservation of the native forests. In 1882 an appropriation of $12,000 was made for forest work for the biennial period; later legislatures have continued this appropriation. A nursery was established and many trees have since been grown, some of which have been distributed for planting on private lands, some of which the government itself has planted.

As a result of the government's planting there has been developed on the slopes of Mount Tantalus, facing Honolulu, a fine forest of euclyptus and other trees, covering several hundred acres. More recently a considerable part of the Nuuanu Valley, which forms the watershed for the water system of Honolulu, has also been planted. Although portions of these are handsome examples of planted forests, and are rightly highly appreciated by the people of the islands, it may fairly be questioned whether they have been profitable, considering their cost. It is certain that they have in no considerable degree compensated for the loss of the native forests during the past twenty years, and it is equally certain that no amount of planting which the government can afford to do can compensate for these losses under present conditions.

The problem must be solved by first protecting the native forests from the forces which are working their destruction, so that as far as possible nature may accomplish their reproduction, and then by judicious planting in those places where the forest is unable to replace itself.

Proposed Forest Service.

The people of Hawaii almost unanimously favor the immediate institution of a system which will protect and restore the mountain forests. Guided by this emphatic sentiment, the last legislature passed a bill creating a forest service, and outlining to some extent a forest policy. Under the law the responsibility of the service rests on a nonsalaried board of agriculture and forestry, whose duty it is to gather and publish information concerning the forests of the islands, to provide for the introduction, propagation, and planting of useful forest trees, to establish forest reserves so far as necessary for the protection, extension, and utilization of the forests and the safeguarding of the sources of water supply, and to protect the forest reserves from damage by cattle and other agencies.

The board is authorized to appoint a superintendent of forestry, who is to be a trained forester, and under the direction of the board is to have immediate charge of all forest work. The superintendent of forestry is to have such paid assistants and rangers as the board may find necessary for handling matters connected with the forests and forest reserves.

The board is also to appoint in each district one or more consulting foresters, who are to serve without pay and advise with the board concerning forest matters in their districts.

A biennial appropriation of approximately $28,000 per year has been made to carry the law into effect.

The board of agriculture and forestry has invited the Bureau of Forestry of the United States Department of Agriculture to assume an advisory position in connection with its future policy. On the nomination of the Bureau a trained forester has been appointed as superintendent of forestry, and has already entered upon his work. Appointments of assistant foresters and rangers are being made as rapidly as the needs of the service require.

Future Policy.

No attempt can be made here to do more than point out the main principles which must govern the future policy of the islands in the maintenance of a forestry system. These are as follows:

FOREST RESERVES.

Nothing less will be effective toward the preservation of the Hawaiian forests than a carefully worked out system of forest reserves, which will include practically all of the mountain forests previously mentioned, as well as some potential forest land which has been denuded. This reserve system should be established as soon as possible, beginning probably in Kula, Hamakua, and Kohala, since in those districts there is greatest immediate need of protection. The Territorial government owns most of the land which should go into the reserves, but the government land is largely held by individuals or companies under leases, some of which will not expire for a number of years. The lessees of many important tracts are willing to relinquish the forest land to the government in exchange for reasonable extension of leases, or for new leases on other lands. Almost all of the reserves will also need to include some land held in fee simple by individuals or companies. Here, again, the only solution of the question is by the government exchanging with the private owners.

It is evident that each reserve will have to be made, a part at a time, as satisfactory exchanges can be made, both in leased and owned lands. The possibility of such exchanges is entirely dependent upon the co-operation of the government with the individuals interested. Good results will be accomplished only when both parties fully understand the importance of the proposed reserve, and enter into negotiation solely to secure fair and equitable exchanges.

As soon as a reserve is formed, all cattle should be driven out and the portions which are accessible to cattle should be fenced. Those wild cattle which can not be driven out should be shot. An effective ranger service should be put into effect to keep stock and fire out of the reserved forest. As soon as practicable, on each reserve men should be employed to hunt down and exterminate the wild goats.

PLANTING.

With the reserves well protected, the forest will replace itself on many of the damaged areas, as reproduction under some conditions takes place rapidly. Where the forest will not replace itself, planting will be necessary, and can be done with direct profit to the islands if commercially valuable species are made use of and are planted in the right situation. Conditions prevailing at 5,000 to 6,000 feet in Kula, Hamakua, and Kau strongly indicate that Pacific coast species, such as redwood and red fir, would do exceedingly well. Eucalyptus, Monterey cypress, Casuarina, Grevillea, and several other trees

have already shown their adaptability for these situations. It is especially important to find trees suited to these and higher elevations, because the native forest is often deficient at such elevations, although the land is good forest land and can never be used for other purposes. In some situations it may be desirable to plant species bearing edible fruit, such as the alligator pear and breadfruit.

For the present, forest planting should wait on the formation of the reserves. Forests already planted on Mount Tantalus and in Nuuanu Valley should be cared for, and the nursery should be maintained, but no extension of planting or of the nursery should be attempted until the reserve system is fairly under way.

LUMBERING.

As soon as practicable, an examination should be made of the koa forest on the east slopes of Mauna Kea and Mauna Loa, to determine whether or not it is feasible to build a road to it and locate a sawmill in it for the purpose of lumbering the mature trees. Some of the koa is without doubt very fine, and would form a source of revenue to the Territory, to which it belongs, if it could be got out without great expense. The law provides that any moneys which shall accrue from such products shall be held available as a special fund for the preservation, extension, and utilization of forests and forest reserves, in the same manner as moneys appropriated by the legislature. This makes it desirable as soon as possible to make the forest revenue producing, so far as this is compatible with its preservation for other useful purposes. It is believed that the situation and composition of the koa forest is such that the removal of the mature trees could be accomplished without damage either to reproduction or to water supply.

CLEARING.

The law makes it mandatory upon the board of agriculture and forestry to pass upon the disposition of any public land, not including roads and city lots. All leases and sales of forest land, carrying the right to cut timber or clear the land, must therefore be approved by the board. Since the clearing of land for the extension of canefields and for homesteads is at the present time making irreparable inroads upon the virgin forest in important localities, it is of special consequence for the board to act with the greatest caution on all permits to clear lands. The only safe attitude for the board to take under present conditions is to assume that all the Government's forests should remain intact, and it should recede from this

position only in those individual cases where the contrary is plainly proved.

EXTERMINATION OF INSECT PESTS.

The effective work which has been done by the entomological service of the islands toward the extermination of certain kinds of injurious insects suggests the possibility of ridding the forests of some of the insects which are devastating them, and furnishes ground for the recommendation that the board, in connection with its entomologists, take the matter into consideration.

ASSISTANCE TO LANDOWNERS.

Throughout the islands there is great interest on the part of both individual and corporate landowners in the development and preservation of forests. And yet the individual is often at a loss to know what trees to plant for his situation—where to get them, how to plant successfully, and how to care for the planted or native forest. This is information which only the trained forester can give. For lack of it some landowners have made no effort in forest work; others have worked with meager results.

It should be a part of the forest policy to give such assistance to landowners as the need requires. Studies should be made on the ground to determine what trees to plant and what methods to adopt, both in the establishment and in the care of woodlands. In many cases it will be beneficial, if not necessary, to assist in procuring seeds and plants, especially those which have to be procured outside of the islands. In so far as the Government nursery is made use of for the production of trees for planting on private lands, the trees should be of valueable economic kinds, and where distributions are made from the nursery the planting should be done under the supervision of the superintendent of forestry.

CO-OPERATION WITH THE BUREAU OF FORESTRY.

The close relation existing between the forest service of the islands and the Federal Bureau of Forestry can be maintained with direct benefit to each. It will strengthen the insular service to have the advice and support of the Bureau in dealing with the problems which it will have to meet. On the other hand, such co-operation will enable the Bureau to keep in as close touch with the forest administration of these important islands as it does with forest affairs in the different States.—Bulletin No. 48 U. S. Bureau of Forestry.

THE NAUDET PATENT PROCESS FOR EXTRACTING AND PURIFYING CANE JUICE.

In forwarding the following notes on a new process of sugar extraction, Mr. Robert Harvey, M. I. Mech. E., writes to the Imperial Commissioner of Agriculture as follows:

"I herewith enclose you a sketch of a new process which we have tested in Madeira, whereby we expect greatly to increase the extraction of sugar from the cane, and, at the same time, to simplify the manufacture and reduce the amount of machinery in the factory.

I have received the order for a large plant, to treat 600 tons of cane per day, for the island of Trinidad, which should be at work about this time next year, when I trust I shall be able to publish reliable figures as regards the saving to be effected by the adoption of this process:

This process, as applied to the cane, is designed to treat single-crushed megass, which, after extraction in the battery, is recrushed by a second mill for final use as fuel.

The process is essentially a systematic washing, or maceration of megass in a battery of eight or more cells, in combination with the filtration of the total output of juice. A centrifugal pump, exterior to the battery, constitutes an apparatus for forced filtration, and includes:—

Two pipe mains, with suction and delivery valve connexions to each cell.

Two straining boxes, for separating cush-cush.

A compensating tank for equalizing the pressure in the cell.

Two juice heaters, worked alternately.

FILTRATION OF LIMED MILL JUICE.

Each cell, in turn, is filled with fresh megass from the cane mill whilst the equivalent yield of mill juice is being limed and heated. The hot juice, with the suspended impurities, is then added to the cell, and the latter connected to the pump. Filtration is complete in from three to five minutes, when the bulk of the mill juice can pass at once to the evaporator. This filtration is effected by drawing the juice from the bottom of a cell, pumping it through a heater, and returning it to the top of the same cell. The motion of the circulated juice is, therefore, downward through the cell of megass and upward through the exterior part of the circuit.

In the meantime, the next cell of the battery has been filled with megass, and another portion of juice limed and heated.

The pump-circuit is therefore shunted to this cell, and fil-

tration effected as before. These operations are repeated round the battery so that the entire output of the cane mill passes into the battery. The Naudet cells form a battery of megass filters, each of which is in operation for about five minutes, so that the filtering medium is always fresh.

MEGASS MACERATION.

In the preceding process of filtration, the two products of the cane mill are reunited in the cells of the battery, and after the filtered juice is withdrawn from any one cell, the residual megass remains saturated with this juice. The recovery of this "free" juice by systematic maceration immediately follows, whereby the sugar normally present in the original megass is likewise extracted. The eight cells form a circuit, the bottom of each cell communicating with the top of the next. The liquid contents of the cells can, therefore, be displaced from cell to cell round the battery, while the megass remains stationary in each cell. This displacement is effected by introducing water under pressure and subsequently compressed air to any cell at a time. The saturated (sweet) megass, from which filtered mill juice has been withdrawn, is successively immersed in seven distinct maceration liquids (i. e., mixtures of juice and water) of diminishing densities, and finally receives fresh water to remove the last trace of sugar.

This final wash-water is then displaced, or driven forward, by compressed air into the next cell, and the exhausted megass is discharged from the bottom of the cell, and delivered to the re-crushing mill.

The new process dispenses with all existing methods of treating the juice between the mill and the evaporator. The entire output of juice is filtered, and that of the megass is macerated. The Naudet apparatus does not occupy much space, and the operations, when once clearly understood, are simple and clean. Being essentially a scientific method, its successful application can only be ensured in factories where chemical control is adopted. Being also a continuous treatment, day and night work is absolutely essential.

The adoption of this process would relieve existing mills of all excessive strain, as it is quite unnecessary to exceed 65 per cent. extraction of juice by the mill. A powerful second mill is, however, required for re-crushing the wet exhausted megass when discharged from the battery.

The results of analyses of the final megass and waste-waters indicate that the loss of sugar by this new method of extraction is less than 1 per cent. on weight of cane; and that the dilution of the normal juice is about half of that required by the usual method of maceration by spraying the megass with water between the mills.

The following additional information relating to the Naudet process, taken from the Consular Report on the trade of Madeira for 1902, appeared in the Agricultural News, Vol. II, p. 339:

The entire cane crop of the island last year was roughly estiamted at 21,000 tons, valued at £57,000, of which amount 6,000 tons were converted into sugar and the remainder into cane spirit for local consumption. All the cane turned into sugar was manufactured by Naudet's diffusion process, and the results obtained surpassed the manufacturer's expectations. The manufactory in question is, I am told, the only cane factory in the world where this process has been tried, and by it the saccharine matter in the cane is almost entirely extracted, and the manufacturing expenses also considerably reduced.

Exhaustive experiments were made by the Naudet process for extracting the sugar which is contained in the megass or cane waste. This process has been tried with excellent results in beet factories, but had never before been attempted with cane. The Naudet patent consists in the diffusion of the megass by means of a forced circulation. The cane is crushed in the ordinary manner and the megass, which still contains a large amount of sugar which cannot be extracted by mill power, is then sent into a battery of diffusors and very nearly all the sugar is drawn by means of a centrifugal pump which sucks up the sweetened water from the bottom diffusor and forces it through a special heater and thence to the top of the same diffusor. The juice is not only sterilized by being brought to boiling point, but is also clarified at the same time. The difference between this and the ordinary diffusion plant is that the cane is not cut into chips but crushed, and that the megass loses none of its properties as fuel. The battery, also, instead of consisting, proportionally, of twelve to fourteen diffusors need only consist of eight or nine. By Naudet's process the juice likewise attains a higher density than by the ordinary process of manufacture.—West Indian Bulletin.

———:o:———

THE MANUFACTURE OF MOLASCUIT.

A New Use for the Waste Materials of the Mill in the Form of Molasses as Food.

The food preparation known as "molascuit" was invented some years ago by Mr. George Hughes, an expert chemist, well known in England among growers of tea, cane, cocoa,

etc. This article (molascuit) is commencing to play a definite part in the sugar industry.

In a word, "molascuit" is a mixture of molasses and bagasse, easily said, but less easily made. An English house, which specializes in the manufacture of crushers of all sorts, gives us some details about the machinery which it has invented for the making of "molascuit." Those of our readers who raise cane will find the description fully as interesting as that of making paper from bagasse. In fact, the bagasse paper factories of Louisiana, which we described, can no longer be said to exist, as they did not pay. Besides this molasses, not bagasse, is the principal constituent of "molascuit," the proportion being only 20 per cent. of bagasse to 80 per cent. of molasses.

The process is essentially this: The bagasse is put through a crusher (disintegrator) just as it comes from the mill; after being ground here, it passes into a separator which detaches from it the larger fibres of which the outer bark of the cane is composed, the intention being to retain only the residuum, or the interior of the cane-stalks. Ordinarily, when it has left the separator, the material passes through a dryer and from there into a hopper placed above the mixer. This hopper is so constructed that it can turn any desired amount of the material into the mixer; here it is ground and mixed with a certain proportion of molasses which is discharged by a reservoir, also placed above the mixer. When the mixing is finished the material is put into sacks or falls into some receptacle to be immediately packed for sale.

Several installations of this description have already been constructed, we are told, and work, it is said, most satisfactorily. It looks as though "molascuit" were making an excellent opening for itself.—Journal Tropical Agriculture, Translation.

THE OUTLOOK IN CUBA.

By Santiago Dod.

In an article published by *The Louisiana Planter* a short time after intervention began, I expressed the opinion that a number of years must pass before Cuba could again reach her maximum sugar output, and that the delay would be due principally to a scarcity in the supply of labor, that must sooner or later hamper her progress in this respect. The rapidity of the increase up to the present time seemed to belie this sup-

position, but since the commencement of the crop that is now coming to a very unsatisfactory end, there have been abundant indications that the impediment I foresaw was finally beginning to give embarrassing proofs of its advent. The enormous yearly increase attained during the preceding years was in part due to influences whose effects might have been generally foreseen had the prevailing conditions created by the recent war been as well understood as they would have been in a similar case in Louisiana, through the weekly reports of correspondents published in your journal; but Cuba, unfortunately, notwithstanding the greater importance of her industry, has no such well organized means of information. Results, however, soon began to show that her largest, her richest and best appointed central factories had escaped the general destruction of the conflict, and that, as I endeavored to show in the article referred to, cane fields in her climate of perpetual summer and in her fertile soil are not so irretrievably ruined by a few years of neglect that they cannot be brought again to a productive yield. Labor, in spite of the immense death rate occasioned by "reconcentration," was by the large reduction of crop made cheap and abundant in the early stages of recuperation. The reduced price of sugar forced those who had the means to compensate the depreciation by increasing their output by every possible resource, and even the encumbered estates were enabled later, by the cessation of the bounty systems in Europe, and the prospect of a reciprocity treaty with the United States, to obtain funds for the restoration of their fields, and the improvement of their factories. The yearly increment was further augmented from another source, and to an extent that circumstances did not seem to warrant, by the rehabilitation of old factories and the building of new upon a very large scale, with unlimited capital from the United States.

Of the two main factors requisite for a very speedy recuperation—capital and labor—we see here that the first was abundantly supplied, and that, consequently, a phenomenally rapid increase was assured to the production of her one great staple, in a country where so disastrous a war had left, with few ex ceptions, the whole population in dire need of obtaining a subsistence by the quickest and most available means that they could command, until the limit of the second factor, labor, was reached. This inevitable result was, under the circumstances, a mere question of time, although it was delayed longer than might have been inferred, through several causes. The influx of Spanish immigrants that has ceased—an unusual tendency to improvement in economizing labor; by the unusual number of boys forced by poverty to premature work in the fields, and also to the fact that many who formerly employed a small number of hands had been reduced to tilling their own

farms, and perhaps as many more who, losing all they possessed, were forced to go to the factories for employment.

It is now clearly evident that, if there is no exaggeration in the reports, a large proportion of this season's cane is destined to be left in the field, because in Cuba, notwithstanding the length of the grinding season, fewer hands are required to grow the crop than to harvest it, and a continuance of the rains may eventually reduce the total output 150,000 to 200,000 tons below the amount generally estimated, in the erroneous supposition that the rate of progress of preceding years could be indefinitely sustained.

This loss has been attributed—and not entirely without reason—to early rains; but that this was not the principal impediment was demonstrated months ago; and had there been no more serious drawback a much larger part of the field would have been ground. At the very outset, at least one large factory that had prepared to work was forced to desist by scarcity of labor, and few, if any, of those that succeeded in obtaining a full enough complement to begin have not complained of being short handed during the harvest. In forming conclusions in regard to this season's results it should not be forgotten that there were delays by rains in May and June last year, and that the middle of the former month has long been accounted the end of the grinding season in normal years, throughout the greater part of the island.

It may reasonably be taken for granted, then, that the limit of the supply of labor in the somewhat wasteful way it has been used was practically reached at the beginning of the crop now concluding, and that under any conditions that can as yet be foreseen the *abnormal* development that has characterized this new era of the Cuban industry, having virtually come to an end, it will be only in the event of some improbable change for the better that its yearly increase in the future will go far enough *per se*, in supplying the demand created by the large increase of consumption in the United States to have any disturbing effect upon your market, if the product is held back for better prices, as it was this year.

Considering the enormous number of the laboring class that disappeared during the war, and the comparatively small aggregations that have since been made to it, it seems very clear that, without a vastly greater advance in the adoption of more modern methods for economizing so vital a factor than has been shown, Cuba could hardly have been expected to have so far made up her heavy losses as to break her own record, in so short a time. There is, however, such an ample margin for improvement that undoubtedly more than ever before will now be done, not only in the adoption of labor saving devices to mitigate this, the one and only important impediment to her further progress, but also in obtaining a better yield by

more scientific work in the sugar house. The statistics of the importation of agricultural implements which give for the month of March a value of $10,155, and for the last nine months of $66,659, against $2,858 and $29,164, respectively, during the same periods in 1903, show that a long stride is being taken somewhere in this direction so far as cultivation is concerned; but as the present year shows conclusively this is not the weakest point in production, as much more cane has been made than could be ground, and also that this new demand is due mostly to American colonists who are not interested in cane cultivation. Judging by the past, and taking into account a certain lack of industrial aptitude, which, although Cuba is more exempt, is a notable failing in all Spanish-American people, no adequate results can be presupposed from this quarter. A continuance, then, of Cuba's rapid progress in sugar production will hereafter depend mainly upon the sufficiency of the supply of new laborers she may obtain. The rate of natural increase is, and will continue to be, an unknown quantity until there is a change of character that will permit the taking of a more exact census, but it is, as compared with that of the United States, very large, and with the improvements in sanitation left by intervention—although in the interior these are much neglected—may be still greater (for the homes of the poor are fairly swarming with children), it may not have much effect upon the sugar output, as it may mostly be absorbed by the increasing demands of other crops now becoming generalized.

If this be true, it seems quite evident that any excessive yearly gains in sugar production hereafter will be due either to abnormally favorable seasons in which the harvest may be unusually prolonged, or to an increase of the labor supply by immigration. There is no basis upon which an opinion can be formed as to the extent of the relief that the central factories may succeed in obtaining from abroad, but this will depend much upon the race and country which eventually supplies the labor. This question was naturally brought up at a recent meeting of the Agrarian League—an association largely representing the sugar interests—and one of the members proposed the introduction of 200,000 picked Chinese as the most suited and available to meet their wants. If this plan were adopted and the Chinese government consents to aid it, the solution of the labor problem would be merely a question of money and the continuance of the large increase attained during the preceding years would be quite possible, if not fully assured; but another member, more in touch with modern aspirations, "sat down upon" this project by declaring himself in favor of European immigration, and opposing the plan upon the ground that an order of the United States authorities during intervention made the Chinese introduction illegal, and that the Cuban Con-

gress would not make itself unpopular by its annulment. In fact, public opinion, to its credit, is so strongly opposed to the admission of the inferior races, of which there is, unfortunately, already a demoralizing preponderance, that although this legislative body be far from representing the real will of the majority, there is one thing as certain as anything can be in the present stage of the disorganization of the young republic—Cuba is destined to become more and more a white man's country, and there is no prospect of a recurrence to the old errors of admitting Africans and Chinese to her soil.

The immigration law demanded by the Agrarian League has not yet been voted, nor is it likely to be in time to avail for the coming crop; nor is there much reason to hope that, when enacted, it will prove the most effective that could have been devised, as the sugar interests are not represented in the present Congress.

The most available and at the same time, all things considered, the best white laborers for Cuba are indisputably those from some of the Spanish provinces and from the Canary Islands. Besides being generally honest, thrifty and inured to the hardest tasks, they are not addicted to politics, and have the great advantage of speaking the same language. As the old scourge of yellow fever that formerly made such havoc among them is no longer to be feared, a considerable number of these, and of the very best class, could be obtained, if trustworthy agents were sent to select them; but they are, as a rule, too poor to come at their own expense, and much less if the immigration law exacts, as it probably will if it be made to serve the best interests of the island, that a good part of them shall bring their families. They will therefore have to be brought either by companies organized for the purpose here or in Spain—as the Chinese were—or by the government or else by the quickest and most reliable way, directly by the employers themselves; for there is little reason to hope, after the failure of so many attempts, that a perfectly independent tide of immigration like that which flows so steadily to the United States will ever be established to any tropical country.

The last of the three courses mentioned appears to have been quite extensively practiced some years ago by an American iron mining company (the Juragua) at Santiago de Cuba, and, so far as generally known, with emphatic success. These laborers, if I am not misinformed, were brought direct in chartered vessels, a large number at a time, and the cost of their passage was gradually deducted from their pay, which was fixed at a dollar per day when they lost no time, and but 90 cents when they were delinquent. This seems to be the only mode open to the central factories for supplying their needs for the coming campaign, but if utilized at all it will in all likelihood be by the large new American companies. Cuban

planters have, from time immemorial, been accused of a great lack of independence in such matters, and of too often waiting for the government to do for them what they might accomplish better and more economically for themselves; and so far as can yet be seen, there is no immediate prospect of any radical change in this respect.

This, however, is not the only obstacle. As these Spanish laborers are entirely unusued to Cuban methods, and have everything to learn in all kinds of special plantation work (unless brought from a very limited section in the southern provinces where cane is cultivated) the introduction of a whole shipload at once to any central factory would, until they became dextrous at their new tasks, entail infinite losses and delays that would imperil the crop; and to bring them in small squads would add too heavily to the expense. These obstacles would impose the necessity of the union of several neighboring employers to bring them conjointly, but here again any such attempt at co-operation would in most cases also encounter an insurmountable obstacle in another characteristic that is but too common, in the intense lack of that spirit of solidarity and co-operation which is, in more advanced communities, doing so much for industrial development. Struggling for years between the Sugar Trust upon one side, and the Cuban commercial monopoly—quite as solid, perhaps, upon the other, the sugar producers of Cuba have never yet been able to find a way to combine effectively for the defense and advancement of so vast an interest. Attempts at association in Cuba—particularly those on a large scale—have generally failed in their purpose, and she seems now as far removed as ever from the best modern tendencies in this field. An offer was made some years ago of laborers from Italy, but from some cause did not meet with much favor, and none were brought. Nevertheless, the need threatens, if not relieved from other sources, to become so pressing that, in spite of the difference of language and some other minor defects, the presence of laborers of this race may become as common in Cuban factories as it is in Louisiana.

Come from whence it may, where land is as easily and cheaply obtained in small lots as it can be in this island, a large quota of the immigrants will, when they have money saved, be lost to the sugar factories either by returning home, or becoming independent by cultivating their own farms, and a very large number will consequently be needed yearly and for a long period, if the demand is satisfied to the full. But the present outlook appears to show that, in any event, the immigration record will henceforth be a truer index of any notable increment in Cuban sugar production than the probable amount of sugar in her cane fields, that has served heretofore. This vital question of labor supply has become so

intricate and complex that nothing very definite can be said as to whence it will come, how large it may prove, how great the demand may really be, and how it will be utilized; but one thing is very certain the whole agricultural industry of the island is in a perplexing state of transition—a very radical one in some phases—and there are so many new tendencies at work in its evolutions that no very safe prognostications can be made as to the more immediate results; but to the large recent extension of the area to cane, and the increased capacity of its sugar factories, together with the new ones building, must now be added not only the extension in the cultivation of tobacco which higher prices will naturally induce, but also the new demand upon her overtaxed labor resources created by her more intimate commercial relations with the United States.

The influence of this new factor may very possibly, in the near future, have an effect entirely contrary to what was expected, by tending to limit instead of augmenting the production of Cuba's principal staple. Cane sugar making is no longer what it was in its most flourishing days, when, with no European competition, a haphazard industry could be built up on a diminutive plantation with such prices that any go-as-you-please management left enormous profits. A large capital is now requisite from the very outset, and the profits are comparatively small. The old tropical industry is consequently losing its hold upon the other Antilles, in favor of crops less affected by competition, and it was to be expected that this tendency would, under new conditions more favorable than those of the other islands, soon invade Cuba.

She is at last, through the advent of colonies of settlers from the United States, fast relinquishing the inevitable practice of putting all her eggs into one basket (or, at most, into two), with the introduction by this more progressive element of the cultivation of new products for the American market, that promise to be more remunerative than cane. These are extending rapidly, and with such diversity that even peaches, heretofore an unattempted crop, have been shipped to New York this year. Although this new industry has only just begun, the increase of its exports is estimated this year at $1,500,000, and, if the reports of the results obtained of cotton are not exaggerated, this also seems destined to extend with a celerity that may make it, next to sugar and tobacco, the most important crop of the island.

This new departure is also having, through the example of American colonists, the result I suggested in the article I have referred to—that of generalizing the use of more labor-saving implements, which will, in due time, become a great economizer, but it cannot be expected to go very far as yet in compensating all these multimillionaires' demands to be made

henceforth upon a restricted supply, which may further cripple the sugar interest. This use of more modern implements may, however, as the new methods of cultivation exact more intelligence and dexterity than mere physical force and endurance, serve, on the contrary, as a relief to a certain extent by drawing a new class of men not fitted for harder tasks to agricultural pursuits. Among the means for attaining this end advocated by the cane planters is the enactment of a new and more rigorous law against vagrancy, in the hope of at least reducing the large number of able-bodied men without any honest means of support, that is to be found throughout the whole island, lounging about the country shops; but there is little reason to expect that, if enacted, it would be any better enforced than its predecessors. More may be gained by an increase in wages, which, however, much employers may oppose it, will be a natural consequence of the scarcity of laborers from the fact that the Spanish silver dollar per day (or about $18 per month) they have been receiving will not, with the unjustifiable advance of the cost of living, leave enough after covering their own expenses away from home, to support a family; and the married are forced to prefer any chance employment within daily reach at less pay than they would earn at the sugar factories. This difficulty may account in some degree for one of the anomalies of the labor supply in Cuba, where it is a common occurrence for many sections to be suffering from want of hands, while the laborers in towns a few miles away are clamoring for work.

This rapid enhancement of the cost of all the necessaries of life threatens, if continued, as it probably will be, to soon reach a stage at which it will, besides more directly augmenting the cost of production by its effect upon wages, react upon the sugar output by becoming a serious check to immigration; and neither public opinion nor a more enlightened sense of the best interests of its authors, is likely to have sufficient influence to keep this evil within bearable bounds. A full explanation of its cause would require too much space here, but its effects seem likely to be too far reaching for it to become a negligible quantity in estimates of Cuba's future well being. —Louisiana Planter.

———:o:———

CUBA'S SUGAR POSSIBILITIES.

The United States Consul-General at Haana, in response to a special request, says the Commercial Intelligencer, has furnished some interesting information relative to sugar production in

Cuba. Although there are some plantations in the country, which, in virtue of some exclusive natural advantage, can produce sugar at from 1¼ to 1⅝ cents per pound, the average cost of production is safely stated at 2 cents per pound. The average yield of one caballeria of good land (a little more than 33 acres) is approximately 614 tons of cane for a period of five years, but virgin soil can be made to yield 1,000 tons of cane. The average yield of sugar from a ton of cane is estimated at from 195 to 235 pounds, according to competency of management and whether modern machinery is used, two factors having an important bearing on the present Cuban sugar output, for no less than 88 per cent. of the present production is accomplished by old style machinery.

By old methods and machinery from 8½ per cent. to 9 per cent. of sugar is produced from cane; by modern methods and machinery from 10½ per cent. to 11 per cent. Competent authorities, however, are of opinion that the success of obtaining a larger percentage depends on the knowledge of planting, the yield of Java sugar being from 14 per cent. to 16 per cent. with old machinery. The agricultural resources of Cuba, the Consul-General says, have never been more than partially developed, its largest crop of sugar—1,054,214 tons in 1894—being made with only a small portion of the available sugar land under cultivation. The area of sugar land is about 51,344 caballerias (12,784 thereof being now devoted to cane production) and with the best machinery and sufficient labor—the scarcity of which at present is remarkable—Cuba could produce a sugar crop of 6,000,000 tons yearly.—Demerara Argosy.

———:o:———

THE IMPORTS OF SUGAR INTO THE UNITED STATES.

[Translation of an article (edtiorial) in the *Diario de la Marina* of May 28, 1904.]

It appears from some very interesting statistics recently published that in 1894, out of 2,041,383 tons of sugar imported into the United States, 1,137,067—or more than 55% of the whole—came from Cuba.

In 1895 and 1896 the exports of sugar from Cuba to the United States were reduced to 944,403 and 210,297 tons, respectively, and they diminished still more during the two following years.

Commencing with 1900 the consequences of the war began to be felt in a lesser degree, the Cuban sugar industry entered upon a period of restoration and the exports to the United States amounted to 651,430 tons in 1901, 893,954 tons in 1902, and 997,154 tons in 1903.

Already in this last year the shipments of Cuban sugar to the United States represent nearly 60% of the total imports as against 55% in 1894, a time in which, before the war, the Cuban production reached its highest point.

According to the decrease of importations of Cuban sugar into the United States, that country had recourse to Europe to provide itself with the correspondingly necessary amount of sugar.

In 1897 the United States imported 757,880 tons of beet sugar, the greater part of which (570,000 tons) came from Germany. Since that time the importation of European sugar into the United States has gone on decreasing progressively, and in the past year it amounted to only 15,177 tons, which is less than 1% of the total imports, these having been 1,664,436 tons in 1903.

Everything appears, therefore, to indicate that the European sugar manufacturers cannot in the future count upon sending a part of their excess production to the United States market, except upon the occurrence of very considerable and unforeseen deficits in cane crops, which could only occur as the result of very extraordinary meteorological conditions.

As regards the other cane sugar producing countries, with the exception of the Hawaiian Islands, which, as an American possession, enjoys favored treatment, their importations into the United States have also been on the decrease. They sent 619,431 tons to that market in 1903, as against 870,110 tons and 1,014,207 tons, respectively, in the two preceding years.

The Hawaiian Islands sent to the United States 429,134 tons in 1903, against 339,886 tons in 1902, and Porto Rico sent 100,623 tons in 1903, against 103,170 tons in 1902. The "Small Article" (Porto Rico) may reach, it is said, a production of 450,000 to 500,000 tons of sugar, but the Hawaiian Islands cannot count upon appropriate lands to increase the cultivation of cane under good economic conditions.

If Mr. Truman G. Palmer, secretary of the Association of American Beet Sugar Manufacturers, is to be believed, the annual exports of the Philippine Islands, which amount at present to about 100,000 tons, as against 263,000 tons in 1891, might reach by means of a rational and complete development of the resources of the Archipelago 10,000,000 or 11,000,000 tons—that is to say, a quantity sufficient for the total consumption of the globe.

In view of the low price at which sugar can be manufactured in the Philippines, the opposition of the American producers

to the project of Mr. Taft, the actual Secretary of War and until recently Governor-General of the Archipelago, to establish free trade in the immediate future between the United States and its colonies in Oceania is not to be wondered at.

If the Philippines were rivals to be so much feared as Mr. Palmer pretends, the free admission of their sugars into the markets of the United States would dampen the ardor of Cuban production and curtail the development of American beet sugar manufacture. As regards Cuba, apart from the fact that its proximity is an advantage of much importance, it could only be in a remote future that the production of the Philippines could constitute a serious danger.

The most likely thing is that during much time, without the necessity of free trade, our Island will supply the United States with the greater part of the sugar it will consume, and when the regimen of reciprocity upon the present basis becomes insufficient to secure a relatively easy market for Cuban products in the United States the course of events, which since 1898 have gone in a fixed direction, will provide for the new necessities, because, as Mr. McKinley said in one of his last messages: "The destinies of the Island of Cuba are already, in a certain measure, irrevocably bound up with those of the United States."—Fed. Reporter.

———:o:———

SUGAR-CANE EXPERIMENT STATIONS IN JAVA.

The following interesting account of the sugar-cane experiment station in Java, and the lines upon which investigations are being carried on, by Dr. J. D. Kobus, is translated from the Revue Agricole of Reunion:

The West Java station was started at Kagok in 1886. For three years it was located in the town of Pekalongan. The East Java station dates from 1887. It has been located from the beginning in the town of Pasoeroean.

Formerly there was a third station—Central Java—founded in 1885. The able director, M. F. Soltwedel, died in December, 1889, after having discovered the possibility of raising sugar-canes from seed. With him also originated the idea of growing sugar-canes in mountain lands at an elevation of 2,000 feet so as to avoid the ravages of the sereh disease. After two or three years the station was closed.

At West Java the first director was W. Krueger, the well-

known author of the German treatise on "Sugar-Cane and Its Culture," in which he has recorded his personal experience in Java (from 1886 to 1891), as well as that of the other station in the island up to 1896. In 1891, he was succeeded by Dr. F. A. F. C. Went, who has gained great distinction by his researches on the diseases of sugar-cane. He was assisted by H. C. Prinsen Geerligs who succeeded him in 1896. The researches of Prinsen Geerligs on sugar manufacture are widely known, also his little work which has already passed through three editions in Dutch and in English.

The first director of the East Java station was Dr. J. G. Kramers. I assisted him as sub-director. In the first few years we were engaged in soil research experiments with various manures, etc. In 1890, the director was succeeded by Dr. J. H. Wakker, a botanist of distinction. He set himself to concentrate our efforts on researches as to the cause of the disease known as "sereh," which threatened entirely to exterminate the sugar-cane in Java. Dr. Wakker made interesting and thorough research in regard to other diseases of the sugar-cane, but, like Dr. Went, he did not succeed in discovering the cause of "sereh."

After ten year's of active work, Dr. Wakker resigned his post for personal reasons. I succeeded him in 1898. Since 1893, I had been editing the Archief voor de Java-Suikerindustrie, a work which I had to relinquish on assuming the directorship of the station. As you know, the chemical selection of the sugar-cane and the raising of seedlings have since occupied the better part of my time. I still, however, continue my researches on the soil and my experiments with manures.

All the publications of our stations are sent to the contributing members of each station. All without distinction can ask for information from each other and all have equal rights to the varieties of sugar-cane and seeds, provided that applications are received before July 1. We raise the canes ordered on their account and in January the seedlings are sent to them and the cost received. Last January more than 17 acres of cane were grown by us for raising seedlings. As soon as the young canes are six months old, each internode can be used as a plant. In January, 1904, our nurseries will be on a still larger scale. Our experiment fields at the same station have an area of 86 acres, containing more than 200 varieties of seedling canes. The best only are distributed to the Usines; before this it is necessary that they should have been carefully proved for four consecutive years.—Agricultural News.

EXPORTS OF JAVA.

The following extracts are taken from the Report on the Trade and Commerce of Java for 1903, by Mr. Consul Fraser. They deal chiefly with sugar:

The sugar crop was a record one, and prices ruled considerably higher than during 1902.

As regards coffee, the total production exceeded the estimates, but values in Europe were anything but satisfactory.

As above mentioned, the production of sugar exceeded that of any previous year, the total reaching 883,020 tons, or nearly 35,000 tons in excess of the year 1902. The results obtained, however, in the various divisions of the island were very dissimilar.

The prices obtained were much more satisfactory than in the preceding year, the lowest point being the equivalent of 7s. 3d. per cwt., as against 6s. 2d. per cwt. in 1902.

Notwithstanding the low values of the last two years, only five mills in all Java have been compelled to close.

The seed cane varieties, originally cultivated by the East Java Experimental Station, and a few other seed varieties have proved a decided success, both as regards production and immunity from disease, and an important increase in the area planted with this description of cane is noticeable. More attention is also being paid to cane selection by the establishment of "selected cane" nursery gardens.

Prospects for the 1904 crop are at present very uncertain. Too much rain has fallen in some districts, and in others drought has prevailed. Everything now depends on the weather conditions during the next few months.

The exports of sugar to the United Sttates—from the 1903 crop up to the end of the year—show a falling off, compared with 1902, of 156,049 tons. Exports to the United Kingdom, which for some years have been practically nothing, according to the official figures, reached 26,126 tons, but the actual quantity was probably somewhat more.

In view of the uncertainty as to the continuance of the United States as the principal consumer of Java sugar, every effort is being made to increase the volume of trade with Eastern markets.—Agricultural News.

NITRE IN CALIFORNIA.

As was predicted by economists and geologists that with the complete exhaustion of the Chilian nitrate deposits in view, in say fifteen or twenty years, a new source of supply would probably be discovered, comes the report of the California State Mining Bureau, declaring that the nitre deposits of San Bernardino County are "rich enough to rival the beds of Chili." Nearly all these beds, which possess many points of geologic similarity to the Chilian deposits, from which 1,606,343 tons were mined last year, are situated in the Northern part of San Bernardino County, extending across the line into Inyo County. "They are found along the shore lines, or old beaches, that mark the boundary of Death Valley, as it was during the Eocene times." The nitre content varies from 7 to 61 per cent. and is associated with varying quantities of common salt, sodium sulphate, calcium sulphate, magnesium sulphate and iodin compounds. The exact extent of these deposits has not been accurately determined, but enough prospecting has been done to establish the fact that they are of sufficient extent to be of national importance. The American Fertilizer simply gives the above for what it is worth, as information. It may not pay to mine a nitre content as low as 7 per cent., much depending upon the location. Any discoveries of nitrate will be welcomed by the fertilizer consumers and manufacturers, but we doubt if California nitrate will be placed upon the market for quite awhile.

JAVA, PRODUCTION OF SUGAR AND EXPORT 1903.

According to the market report of the Batavia Chamber of Commerce, the production in 1903 amounted to 897,323 tons, of which 508,614 were produced in Eastern Java, 232,307 in Middle Java, and 156,402 tons in Western Java.

The export was 883,377 tons as against 754,656 tons in 1902. The destination of those sugars was as follows:—

Hongkong	245,093	tons.
United States of America	149,268	"
Japan	130,826	"
Mediterranean	86,406	"
Australia	78,945	"
India	69,165	"
Singapore	48,631	"
Barbados	37,754	"

THE INFLUENCE OF LIGHT ON CRYSTALLIZATION.

Small glass cylinders were filled with a weighed quantity of 70% sugar solution, carefully stoppered and parafined. The small cylinders were placed in vessels of 10 C. M. diameter, filled with a liquid which had to serve as a filter for the light. Thus there was a layer of 3.7 C. M. through which the light had to pass before it could act on the solution.

Three of these tests were made, one with red, one with yellow, and one with blue rays. The filter for the red light consisted of an alkaline solution of phenolphtaleine. That for the yellow rays of a solution of bichromate of potash, that for the blue rays of an ammoniacal solution of copper. These solutions were tested in a layer of 3.7 C. M. with a spectroscope and brought to an even intensity.

After a week the cylinders were opened and the crystals which had been formed during that time weighed. The result was as follows:—

	1st Test.	2nd Test.	3rd Test.
Weight of crystals	1.51 grs.	1.55 grs.	1.85 grs.

It appears from this that the blue rays were the most effective.

—Gelbe Hefte 1903. blz. 329.

Sugar Plantations, Cane Growers and Sugar Mills.

ISLAND AND NAME.		MANAGER.	POST OFFICE.
OAHU.			
Apokaa Sugar Co.	*	C M Roberts	Ewa
Ewa Plantation Co.	*	G. F. Renton	Ewa
Waianae Co.	***	Fred Meyer	Waianae
Waialua Agricultural Co.	*	W. W. Goodale	Waialua
Kahuku Plantation Co.	x*	Andrew Adams	Kahuku
Waimanalo Sugar Co.	**	G. Chalmers	Waimanalo
Oahu Sugar Co.	x	Aug. Ahrens	Waipahu
Honolulu Plantation Co.	**	J. A. Low	Aiea
Laie Plantation	x*x	S. E. Wooley	Laie
MAUI.			
Olowalu Co.	**	Geo. Gibb	Lahaina
Pioneer Mill Co.	x	L. Barkhausen	Lahaina
Wailuku Sugar Co.	**x	C. B. Wells	Wailuku
Hawaiian Commercial & Sug. Co.	x*	H. P. Baldwin	Puunene
Paia Plantation	x*	D C. Lindsay	Paia
Haiku Sugar Co.	x*	H. A. Baldwin	Haiku
Hana Plantation	xx	E. Worthington	Hana
Kipahulu Sugar Co.	x	A. Gross	Kipahulu
Kihei Plantation Co.	x*	James Scott	Kihei
Maui Sugar Co.	x**	J. R. Meyers	Huelo
HAWAII.			
Paauhau Sugar Plantation Co.	**	Jas. Gibb	Hamakua
Hamakua Mill Co.	*x	A. Lidgate	Paauilo
Kukaiau Plantation	x	J. M. Horner	Kukaiau
Kukaiau Mill Co.	*x	E. Madden	Paauilo
Ookala Sugar Co.	**x	W. G. Walker	Ookala
Laupahoehoe Sugar Co.	*x	C. McLennan	Papaaloa
Hakalau Plantation	**	Geo. Ross	Hakalau
Honomu Sugar Co.	**x	Wm. Pullar	Honomu
Pepeekeo Sugar Co.	*x	H. Deacon	Pepeekeo
Onomea Sugar Co.	**x	J. T. Moir	Hilo
Hilo Sugar Co.	**	J. A. Scott	Hilo
Hawaii Mill Co.	x	W. von Gravemeyer	Hilo
Waiakea Mill Co.	*x	C. C. Kennedy	Hilo
Hawaiian Agricultural Co.	**x	John Sherman	Pahala
Hutchinson Sugar Plantation Co.	**	Carl Wolters	Naalehu
Union Mill Co.	*x	Jas. Renton	Kohala
Kohala Sugar Co.	*	E. E. Olding	Kohala
Pacific Sugar Mill	x**	D. Forbes	Kukuihaele
Honokaa Sugar Co.	x**	K. S. Gjerdrum	Honokaa
Kailua Sugar Co. C. J. Hutchins			Holualoa
Olaa Sugar Co. (Bishop & Co)		J. Watt	Olaa
Puna Sugar Co.	xx*	W. H. Campbell	Kapoho
Halawa Plantation	x*x	T. S. Kay	Kohala
Hawi Mill & Plantation	††	John Hind	Kohala
Puako Plantation	††	W. L. Vredenburg	S. Kohala
Niulii Sugar Mill and Plantation	*x	Robt Hall	Kohala
Puakea Plantation	*x	H. R. Bryant	Kohala
KAUAI.			
Kilauea Sugar Plantation Co.	**	A. Moore	Kilauea
Gay & Robinson	x*x	Gay & Robinson	Makaweli
Makee Sugar Co.		G. H. Fairchild	Kealia
Grove Farm Plantation	x	Ed. Broadbent	Lihue
Lihue Plantation Co.	x	F. Weber	Lihue
Koloa Sugar Co.	x	P. McLane	Koloa
McBryde Sugar Co.	*x	W. Stodart	Eleele
Hawaiian Sugar Co.	x*	B. D. Baldwin	Makaweli
Waimea Sugar Mill Co.	*	J. Fassoth	Waimea
Kekaha Sugar Co.	x	H. P. Faye	Kekaha

KEY.

*	Castle & Cooke (4)
**	W. G. Irwin & Co. (8)
***	J. M. Dowsett (1)
x	H. Hackfeld & Co. (9)
xx	M. S. Grinbaum & Co. (2)
*x	T. H. Davies & Co. (8)
**x	C. Brewer & Co. (7)
x*	Alexander & Baldwin (5)
x**	F. A. Schaefer & Co. (3)
xx*	B. F. Dillingham & Co. (1)
x*x	H. Waterhouse & Co. (3)
††	Hind, Rolph & Co. (1)

HONOLULU AGENTS.

HONOLULU STOCK AND BOND EXCHANGE, OCT. 26, 1904.

STOCK	Capital Authorized	Shares Issued	Capital Paid up	Par Value	Last Sale
MERCANTILE					
C. Brewer & Co.	$ 1,000,000	10,000	$ 1,000,000	$ 100	305
SUGAR					
Ewa Plantation Company	5,000,000	250,000	5,000,000	20	23⅜
Hawaiian Agricultural Co.	1,200,000	12,100	1,200,000	100	102½
Hawaiian Com'l & Sugar Co.	10,000,000	100,000	2,312,750	100	66
Hawaiian Sugar Company	2,000,000	100,000	2,000,000	21	27½
Honomu Sugar Company	750,000	7,500	750,000	100	116
Honokaa Sugar Company	2,000,000	100,000	2,000,000	20	16
Haiku Sugar Company	500,000	5,000	500,000	100	130
Kahuku Plantation Company	500,000	25,000	500,000	20	19
Kihei Plant. Co. Ltd.,	2,500,000	50,000	2,500,000	50	12
Kipahulu Sugar Company	160,000	1,600	160,000	100	
Koloa Sugar Company	500,000	5,000	500,000	100	125
McBryde Sug. Co. Ltd.	3,500,000	175,000	3,500,000	20	4
Oahu Sugar Co	3,600,000	36,000	3,600,000	100	97
Onomea Sugar Co	1,000,000	50,000	1,000,000	20	24
Ookala Sugar Plantation Co.	500,000	25,000	500,000	20	6
Olaa Sugar Co. Ltd.,	5,000,000	250,000	5,000,000	20	3¾
Olowalu Company	150,000	1,500	150,000	100	60
Paauhau Sug. Plantation Co.	5,000,000	100,000	5,000,000	50	12
Pacific Sugar Mill	500,000	5,000	500,000	100	
Paia Plantation Company	750,000	7,500	750,000	100	135
Pepeekeo Sugar Company	750,000	7,500	750,000	100	
Pioneer Mill Company	2,750,000	27,500	2,750,000	100	120
Waialua Agricultural Co.	4,500,000	45,000	4,500,000	100	48½
Wailuku Sugar Company	700,000	7,000	700,000	100	275
Waimanalo Sugar Company	252,000	2,520	252,000	100	160
MISCELLANEOUS					
Wilder Steamship Company	500,000	5,000	500,000	100	115
Inter-Island Steam Nav. Co.	600,000	6,000	600,000	100	102½
Hawaiian Electric Company	500,000	5,000	500,000	100	102½
Honolulu R. T. & Land Co.	1,250,000	P. 3,390 C. 8,000	1,139,000	100	100 65
Mutual Telephone Company	150,000	15,000	150,000	10	10
Oahu Railway & Land Co	4,000,000	40,000	4,000,000	100	70
Hilo Railroad Co.	1,000,000	50,000	1,000,000	20	17
BONDS	Auth. of Issue		Amt. Issued		
Haw. Terr'l. 4 per cent Fire Claim)	$ 326,000		315,000		96
Haw. Terr'l. 4½ per cent	5,000,000		1,000,000		
Hawaiian Govt. 5 per cent.	936,000		870,000		100
Haw. Com'l & Sug. Co. 5 p. c.	2,500,000				
Ewa Plantation 6 per cent.	500,000		300,000		100
Haiku Sugar Co., 6 per cent	300,000				100
Haw. Sug. Co. 6 per cert.	700,000				
Hilo Railroad Co., 6 per cent	1,000,000		1,000,000		100
Hono. R. T. & L. Co , 6 p. c.	1,000,000		610,000		105
Kahuku 6 per cent	200,000		200,000		100
Oahu Railway & L'd Co. 6 p. c.	2,000,000		2,000,000		104
Oahu Sugar Co. 6 per cent.	750,000		750,000		100
Olaa Sugar Co. 6 per cent.	1,250,000		1,250,000		100
Paia Plant. Co., 6 per cent	450,000				100
Pioneer Mill Co., 6 per cent	1,250,000		1,250,000		100
Waialua Agr. 6 per cent.	1,000,000		1,000,000		100